Third Report of the
International Technical Working Group
For the
European Grape Vine Moth (EGVM) in California

FINAL---DECEMBER 7, 2010

A subset of the Technical Working Group (TWG) for the European Grape Vine Moth (EGVM) program in California met in Napa, California on November 8-10, 2010. TWG members attending: V. Mastro (Chair), R. Cardé, C. Ioriatti, D. Lance, A. Lucchi, L. Sazo, G. Simmons, R. Steinhauer, and L. Varela. The following members could not attend, due primarily to logistical reasons: B. Bagnoli, G. Wegner-Kiss, G. Barrios, and R. Sforza. Program personnel from federal, state, and county levels provided the TWG members in attendance with a summary of activities and results from the 2010 season. The TWG then met separately to formulate responses to a series of questions from the program.

Overview

The TWG wishes to commend all involved for pulling together a substantial effort to detect, delimit, suppress, and limit the spread of European grapevine moth, *Lobesia botrana* (EGVM), populations in California. The effort was especially noteworthy given the limited resources available to fund the operations of the 2010 season.

At this point, the TWG believes that a wide variety of program goals, including eventual eradication of EGVM from California, remain technically feasible. Following its April 2010 meeting, the TWG provided three conditions for the continued feasibility of eradication, and they still apply:

1. The population is not (and does not become) substantially more widespread than it is known to be at the present time;
2. The grape industry remains behind the effort; and,
3. Control methods that are available at the present time remain available for use by the program.

Eradication, as well as a number of other potential goals (e.g., containment and suppression), will require a well-designed and well-coordinated area-wide program:

1. The TWG acknowledges that EGVM program managers have generally done an outstanding job of coordinating treatments among growers as well as other aspects of the program. However, as the program moves forward, a centralized management structure will be critical. Protocols should be standardized across the program, and central management will need the effective authority to ensure compliance. The TWG recognizes that such central authority would be problematic at FY 2010 funding levels.
2. Gaps in treatment and other program activities will have to be eliminated. These would include non-compliant growers as well as residential and natural areas that may harbor potential hosts (especially grapes). Intensive monitoring and effective suppression of EGVM populations will have to be applied uniformly across affected areas as the program moves toward de-regulation and eradication.

3. A centralized database should be put into place. The database would track survey, treatment, and other program activities and include geospatial and regulatory information.

Responses to specific questions and issues:

A. Suppression treatments:

Treatment area: Previously, the TWG recommended that treatments should be applied within all areas that are under regulation to a distance of 1000 m from positive trap finds. Given that we now have a better understanding of the distribution of the pest, and that populations overall, appear to have been substantially reduced, that distance can be reduced to 500 m. This standard should be applied across all program areas. At the end of the 2011 EGVM season, the program data should be reviewed to determine this recommendation's effectiveness.

Insecticide options: In 2010, a variety of insecticide products was available for use against EGVM, and most appeared to work well. Initial data suggest that insect growth regulators such as methoxyfenozide ("Intrepid") may have slightly out-performed a number of other options, but growers (or program managers) should continue to select products based on the situation and need. For organic operations, spinosads were generally somewhat more effective than Bt but were also more expensive. Timing of Bt application is critical, and it is unknown if or to what degree these timing issues affected this product's efficacy.

The TWG believes that the season's first and second generation larvae (and/or eggs) should be treated with insecticides, but that the third generation generally should not be--barring extenuating circumstances (note that this does not apply to mating disruption, which should be applied against all generations). Treatments should continue until the area is deregulated.

Use of mating disruption: Mating disruption is an effective adjunct to conventional insecticide treatment[1] and should be used wherever practical throughout all treatment areas, with the exception of areas under high-density trapping that we are recommending prior to the lifting of quarantines (see *Recommended procedures for deregulation*, below). Mating disruption should be used against all generations. Mating disruption treatments should be in place in the spring before emergence of the first flight of adult moths is expected.

The TWG was asked about the utility of attract-and-kill methods as an alternative to mating disruption. This method tends to be somewhat more problematic than straight mating disruption, and there is no data to suggest that, for EGVM, that it would be more efficacious. In addition, there currently are no attract-and-kill-type products registered or (as far as we know) under development for use against EGVM.

[1] The actions of insecticides and mating disruption are complimentary in that the effectiveness of insecticides is generally density independent whereas that of mating disruption is inversely density dependent. In other words, insecticides tend to kill roughly the same proportion of insects regardless of how many insects are in an area. In contrast, mating disruption becomes increasingly effective as insect populations become sparser. Mating disruption interferes with the chemical communication system that male moths use to locate females, such that mating will occur only if a male stumbles across a female more or less at random. For any given female, fewer males in the surrounding area translate into a lower probability that one of them will stumble across and mate with her. While mating disruption has not to date been widely used as an eradication tool, its inverse density dependence means that it is theoretically useful for eliminating the final vestiges of a moth population, especially if the population has been previously reduced to very low levels by other tactics such as insecticide applications.

Alternative treatment methods: Alternative methods such as fruit-stripping and other sanitary measures may prove valuable for EGVM control in residential neighborhoods and perhaps in unmanaged areas to the degree that hosts can be located and removed or otherwise made unacceptable to EGVM. Bark-stripping to remove overwintering pupae is not recommended as a program activity due to its low effort-to-benefit ratio, but if individual growers wish to do this, they should be free to do so.

B. Survey:

The ongoing survey effort has done a good job of delimiting the EGVM population in the Napa area and in detecting smaller populations in outlier sites. Survey should continue with the following augmentations:

- Increase detection-level trapping systems from 16 to 25 traps per square mile.
- Increase trapping in areas being assessed for deregulation to 100 traps per square mile (in 500-m treatment zone only; see *Recommended procedures for deregulation*, below).
- Increase trapping levels in residential and natural areas within regulated zones to levels used in comparable grape production areas (i.e., treated or untreated). Traps in these areas should not be rotated.
- Develop a consistent plan to conduct detection trapping in high-risk residential areas outside of the regulated zone; e.g., piggy-back EGVM onto fruit fly and glassy-winged sharpshooter trapping programs where applicable.
- Continue efforts to geocode all trapping (and treatment) data and improve data quality assurance measures; e.g., coordinates of trap sites are sometimes outside of the county where the trap was actually placed.
- Outside of California, a targeted survey should be conducted at sites that are receiving or have recently received grapes from California, especially in cases where grapes for wine-making have been received by vineyards. Ideally, a proportion of vineyards (10% or more) should also be surveyed. These surveys can be coordinated through the Cooperative Agricultural Pest Survey's grape commodity survey.

Trapping should commence before the predicted start of the adult flight season, based on degree-day modeling. Trapping should continue throughout the flight season. Entry into diapause appears to be determined primarily by photoperiod rather than temperature, making it possible to stop trapping based largely on calendar dates. As such, capture data from 2010 suggest that traps should be left in place until mid October.

Program staff also asked the TWG about the potential usefulness of alternate trapping methods such light traps or traps baited with food lures, especially in relation to monitoring EGVM in areas where mating disruption treatments have been applied. The TWG does not believe that there are sufficient data available to judge the value of these traps for program use without further assessment (see *Research Recommendations*). Similarly, data are not available to support the use of paper delta traps with the ends folded inward as they are, for example, for gypsy moth detection.

Visual inspection of clusters: The TWG does recommend visual surveys of vines for immature EGVM, in addition to trapping, to monitor populations under mating disruption. Because mating disruption treatments reduce the efficiency of traps, it is important to conduct this supplementary sampling to monitor EGVM populations and assess the effectiveness of treatments. Visual

inspections should be done in the first generation only. At each trap site within the treated area (25 sites per square mile within 500 m of finds) inspect 100 clusters. Larval development in the first generation goes from cluster extension to fruit set, which provides a period of ~50 days when these inspections can take place. This process should require 15-20 min per sample of 100 clusters.

C. Regulatory issues:

How should we regulate grapes shipped out of state? Current regulations for grapes and 'must' shipped out of state generally look adequate. There was a specific question about the need for refrigeration. Maintaining grapes at temperatures approaching freezing will contribute to mortality and slow both the development and motion of any EGVM, reducing the risk of escape *en route*. The TWG continues to recommend transporting grapes to out of state sites in closed, refrigerated containers.

Host plants and host materials:

- Olives – olives appear to be a potential EGVM host only when flowering. Olive fruit do not need to be regulated, even in cases where twigs and stems are present.
- Stone fruit – there is a protocol in place for management of and inspection for EGVM in stone fruit. It appears appropriate and should be maintained until further research demonstrates that the pathway is not a risk for movement of EGVM. This protocol should provide for interstate shipment of stone fruit with minimal amounts of disruption and cost. The TWG realizes that constraints by foreign trading partners can seriously affect international trade in these commodities, but these matters are beyond our scope or control.
- Grape tissues for lab analysis – the TWG believes that petioles and leaf blades shipped to labs for analysis do not pose a risk and should not be regulated. Other plant materials (trunk, etc.) require regulation, and these regulations should be standardized among counties. Also, regardless of the regulatory status of leaf blades and petioles, an effort should be made to certify all laboratories used by growers.
- Other alternate hosts – of the other potential hosts, only *Daphne gnidium*, the presumed ancestral host of EGVM, appeared to be of concern to most TWG members. *D. gnidium* is not known to occur in California but has been reported as an invasive weed in the state of Washington.

Grape processing waste:

Pomace – prior to disposal, white wine pomace should be treated by pressing to a minimum of 2 bars and/or treated per protocols for handling green waste. Red wine pomace has been through fermentation and is not considered to be at risk for containing live EGVM.

Green waste from wineries – green waste should be composted in approved facilities, heat treated, or disposed of by other approved methods. In addition to existing treatment protocols, the TWG was asked if chopping, grinding or shredding would be acceptable stand-alone treatments for eliminating risk associated with green waste. The TWG's response is that we do not have sufficient information to comment. If these treatments would be sufficiently useful to growers, studies can be conducted to determine if they are effective. It should be noted that even with much larger insects such as immature stages of wood-boring beetles, host materials must be

reduced to one inch or less in two dimensions to ensure that chipping is an effective phytosanitary treatment.

Regulated areas:

The TWG continues to recommend regulation of areas within five miles of positive traps or finds of other EGVM life stages. With that said, program managers should exercise judgment when setting boundaries of regulated areas and may consider the presence of broad host-free areas, geophysical features such as mountain ranges, or other potential barriers to movement of EGVM.

Recommended procedures for deregulation:

The TWG was asked for recommendations on protocols to follow in releasing areas from regulation (associated with declaring a local population eradicated). Note that the response below applies to isolated infestations beyond the larger regulated area that is centered in Napa County. Strategies for deregulating that larger area should be developed if and when the time comes. In general (and this applies to Napa and the all other infested counties), deregulation should occur in large blocks. In most counties other than Napa (and perhaps Sonoma), all portions of an entire contiguous regulated area should typically be deregulated at the same time. Deregulation cannot proceed on a vineyard-by-vineyard basis as regulation of the remaining area would become extremely difficult, and re-invasion of EGVM into previously regulated areas would be difficult (or impossible) to prevent.

The TWG discussed this issue at some length and felt that areas should not be released from regulation until five consecutive generations have passed without EGVM being found in the regulated area. Control treatments should continue throughout this period. For the final two generations (at least), trapping should be conducted at 100 traps per square mile within the treated area (i.e., within 500 m of sites where moths had been captured or other life stages found). Traps within that area should be distributed (spaced) as uniformly as is practical both within and beyond vineyards wherever host material exists. Mating disruption cannot be applied during the period of high-density trapping (but is encouraged for earlier generations); in fact, old pheromone dispensers should be located and removed from the area. The TWG realizes that requiring five generations is more stringent than protocols for some other pest programs; however, uncertainties about the sensitivity of trapping systems for the insect, along with its apparently limited flight range, suggest that a conservative approach is warranted[2].

[2] Deregulation in a program such as this is based upon a high degree of confidence that a population of the pest in question no longer exists in the area. When trapping or using other available sampling methods, there is never a 100% probability of detecting an existing population (especially a small population); thus, we can never, based on sampling data, be 100% sure that a population has been eradicated. What we can say, if we know enough about the way a sampling system functions, is that if we do not catch any insects, we have a certain level of assurance (say 90% or 95%) that a population no greater than some specific number of insects existed in the area where the trapping took place. That is a statement of the sensitivity of the trapping system, which is dependent on a number of factors including (among many others) the number of traps per unit area, the effectiveness of the trap and lure, and the flight ability and activity level of the insect. For EGVM we do not know most of these things, though available information on flight range suggests that trapping systems (with the same number of traps) will be somewhat less sensitive for EGVM than, say, for Mediterranean fruit fly, and *much* less sensitive than comparable trapping systems for gypsy moth or oriental fruit fly. Current protocol for Mediterranean fruit fly requires three generations of negative trapping, utilizing a grid of 100 traps per square mile before eradication is declared. We believe that a more stringent standard is appropriate for EGVM.

The degree of assurance that a population has been eradicated is influenced by both the sensitivity of the sampling system and time. Very small populations are typically unstable and, over a number of generations, will

Research and/or Methods/Development Needs (not prioritized, though items in **bold** are short-term needs):

Monitoring:

- **Determine the utility of high-load pheromone lures, light traps, food-lure traps, etc., for monitoring EGVM populations in areas under mating disruption treatments.**
- **Develop/validate sampling systems for assessing populations of immature EGVM in fields (for use in monitoring to assess risk of moving grapes out of quarantine zone for crush and for assessing mating disruption effectiveness).**
- **Optimize trap design (includes looking at folding of flaps in delta traps).**
- **Determine sensitivity of the detection and delimitation systems (would have to be done abroad at this point).**
- **Validate the degree-day model.**

Ecology, behavior, biology, biological control:

- **Continue work to determine what alternative hosts are used by EGVM in California.**
- **Determine factors that control entry into diapause; i.e., is it possible that many EGVM in Napa go through only two generations in a growing season?**
- Evaluate genetic diversity in EGVM.
- Characterize adult behavior (flight, mating, oviposition, resting).
- Evaluate possibility of using biological control agents to reduce populations.
- Characterize population dynamics of EGVM in California, including effects of natural enemies.
- Develop a spread model.

Control and management:

- Develop enhanced systems for monitoring and evaluating an area-wide EGVM management program.
- Develop/assess new mating disruption formulations for EGVM, including machine-applied.
- **Continue to assess insecticides and develop lists of "best" insecticides for use in conventionally managed vineyards, organic vineyards, and sensitive areas (e.g., riparian, urban and suburban areas). Encourage registration of promising compounds and products for use against EGVM.**
- **Determine optimal timing and use patterns for products with short field life such as Bt.**

---

tend to either grow (such that detection in the trapping system will become likely) or go extinct. The TWG believes that the protocol outlined above will provide, to the best of our current knowledge, a reasonably high level of confidence that the population in the area either will be detected or is no longer present.

Develop Sterile Insect Technique methodology for EGVM:

- Improved rearing technology.
- Radiation biology – identify dose and methods for producing fully sterile and F1-sterile male EGVM.
- Develop release technology.
- Evaluate field competitiveness of sterile moths.

Regulatory:

- **Develop and/or confirm regulatory treatments for grapes (table, wine, raisin).**
- **Develop regulatory treatments for grape nursery stock; confirm efficacy of hot-water dip.**
- **Investigate pathways that could move EGVM to new areas. Also, how did it get to Napa?**
- **Evaluate/develop improved methods of transporting grapes within California to reduce incidence of new EGVM finds in the vicinity of wineries that are outside of regulated areas.**
- **Confirm efficacy of/develop improved methods for handling, composting, or otherwise treating winery waste to minimize risk. In particular, look at mechanical treatments for green waste (shredding, grinding, etc.).**
- **Determine if EGVM life stages can survive the crush process and survive in unfermented pomace.**
- **Confirm that processing grapes into raisins will kill all EGVM life stages.**

Economic assessment of EGVM in California and North America.

- This has been completed and is under final review with a December 10, 2010 deadline for publication.